**BEFORE
THE PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA**

DOCKET NOS. 2019-224-E and 2019-225-E

In the Matter of:	)
	)
South Carolina Energy Freedom Act (House Bill 3659) Proceeding Related to S.C. Code Ann. Section 58-37-40 and Integrated Resource Plans for Duke Energy Carolinas, LLC and Duke Energy Progress, LLC	))))))

SURREBUTTAL TESTIMONY OF ARNE OLSON

ON BEHALF OF

CAROLINAS CLEAN ENERGY BUSINESS ASSOCIATION

Q1. PLEASE STATE FOR THE RECORD YOUR NAME, POSITION, AND BUSINESS ADDRESS.

A: My name is Arne Olson. I am a Senior Partner with Energy and Environmental Economics, Inc. ("E3"), located at 44 Montgomery Street, Suite 1500, San Francisco, California 94104, USA.

Q2. HAVE YOU PREVIOUSLY FILED TESTIMONY IN THIS PROCEEDING?

A: Yes, my Direct Testimony was filed in this proceeding on February 5, 2021.

Q3. PLEASE PROVIDE THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY.

A: The purpose of this testimony is to respond to the rebuttal testimony of Duke Energy, namely the testimony filed by Witnesses Snider and Wintermantel.

Q4. HOW IS YOUR SURREBUTTAL TESTIMONY ORGANIZED?

A: My testimony is organized in three sections:

1. In Section 2, I respond to the comments of Witness Wintermantel.
2. In Section 3, I respond comments of Witness Snider.
3. In Section 4, I describe the inconsistencies between Witness Wintermantel and Witness Snider and note my position.

Q5. WITNESSES SNIDER AND WINTERMANTEL BOTH STATE THAT THEY WERE UNABLE TO OBTAIN RESPONSES TO DISCOVERY

REQUESTS RELATED TO YOUR TESTIMONY. DO YOU HAVE ANY COMMENTS ON THE DISCOVERY PROCESS?

A: Witnesses Snider and Wintermantel both assert that CCEBA "refused" to provide responses to discovery questions by Duke Energy. While I am not an attorney, my understanding is that CCEBA objected to a number of the discovery requests made by Duke in this proceeding, which is why Duke did not receive the referenced responses. It is also my understanding that CCEBA did provide data and documents pursuant to Duke's Requests for Production of Documents. I further understand that Duke has received responses to many of its questions relating to my testimony and report through requests made in the North Carolina IRP proceeding being conducted in parallel with this proceeding.

<u>RESPONSE TO WITNESS WINTERMANTEL</u>

Q6. PLEASE PROVIDE AN OVERVIEW OF WITNESS WINTERMANTEL'S REVIEW.

A: In his rebuttal Witness Wintermantel responds to my testimony, specifically noting:

1. He believes that an ELCC surface is not required to properly model the capacity contribution interactions between solar and storage, while stating that the diversity benefit of solar and storage has been included in the analysis and has been attributed to storage resources, and
2. He disagrees that storage resources should be modeled in "preserve reliability" mode.

Q7. IN YOUR OPINION HAS WITNESS WINTERMANTEL ACCURATELY CHARACTERIZED THE USE OF AN ELCC SURFACE?

A: No. Witness Wintermantel states in his Rebuttal Testimony that an ELCC surface is unnecessary as the ELCC values generated in the Astrapé studies include diversity benefits.

There are two errors in this characterization. First, the current capacity expansion software used by Duke does not include storage as a candidate resource. Accordingly, his assertion that the diversity benefit is accounted for in expansion planning process[1] through the ELCC values of storage is inaccurate.

Second, while I agree that the values calculated for storage incorporate diversity benefits, because an arbitrary fixed amount of solar was assumed to be part of the system when those values were calculated, they do not consider the interactive effects of changing penetrations of renewable generation and energy storage. To fully and appropriately identify the diversity benefits of resources, and accurately account for those resources in the modeling, it is necessary to incorporate the interactive effects of changing penetrations of resources.

Using the ELCC curves calculated for storage by Astrapé in Duke's capacity expansion modeling would be the equivalent of assuming a fixed amount of pre-determined solar generation, regardless of the capacity expansion optimization results. Put another way, there would be no change to the ELCC for storage in the

[1] Rebuttal Testimony of Nick Wintermantel – pg. 32

capacity expansion modeling if the optimization chose 0 MW or 10,000 MW of solar, which is clearly incorrect. As I discussed in my Direct Testimony, the ELCC of a given resource will change depending upon the amount of other resource types on the system as well as the system load. The use of an ELCC surface is necessary to account for these dynamic, interactive effects, enabling the capacity expansion model to accurately include and value the ELCC of available resources.

Q8. DOES THE INCLUSION OF THE DIVERSITY BENEFIT IN THE STORAGE ELCC VALUES REMOVE THE NECESSITY OF USING AN ELCC SURFACE TO ACCURATELY MODEL CAPACITY EXPANSION?

A: No. As stated above, the Astrapé study has arbitrarily determined the amount of diversity benefit to be credited to the storage resources by assuming a fixed level of solar. The use of an ELCC surface is necessary to accurately model the capacity contributions of solar and storage resources under changing penetrations.

Q9. WITNESS WINTERMANTEL STATES THAT A 6% REDUCTION IN THE ELCC VALUE ATTRIBUTED IS A "RELATIVELY SMALL DISCOUNT". DO YOU AGREE?

A: No. In his testimony, Witness Wintermantel responds to my testimony that battery storage should be modeled in "preserve reliability mode" rather than "economic arbitrage mode" to more accurately account for the way system operators are able to dispatch storage to maximize its value, especially during extreme winter events. Witness Wintermantel acknowledges that modeling storage in preserve reliability mode would result in an increased ELCC for storage, but he argues that a 6%

reduction in the ELCC value of stand-alone storage due to modeling the resource under and economic arbitrage assumption as opposed to my recommendation of preserve reliability is a "relatively small discount".[2]

A 6% change in the ELCC value for any resource is significant. As a comparison, the forced outage rates assumed for thermal generating resources are often in the 5% range. If 6% were to be a "relatively small discount" for storage, then it would stand to reason that the thermal outage rates are equally inconsequential which is certainly not the case.

Q10. WITNESS WINTERMANTEL ASSERTS THAT SEASONAL OUTAGE RATES FOR THERMAL RESOURCES SHOULD BE USED TO CALCULATE ELCC VALUES. DO YOU AGREE?

A: Yes, if that information is available. In the discovery process we requested information from Duke regarding seasonal outage rates. However, Duke provided only equivalent annual rates, and did not provide seasonal information.

Q11. IN YOUR DIRECT TESTIMONY, YOU STATED THAT LOAD IS AN IMPORTANT FACTOR IN DETERMINING THE ELCC OF RESOURCES. HAVING REVIEWED HIS TESTIMONY, DOES WITNESS WINTERMANTEL AGREE WITH YOU?

[2] Rebuttal Testimony of Nick Wintermantel – pg. 36

A: Witness Wintermantel did not comment on my assertion that load is a fundamentally important factor when determining the ELCC values for resources. Witness Wintermantel does note that 2040 is not an appropriate year to use as it is outside of the current planning horizon, however he provides no justification for the use of 2024 which would result in the ELCCs being calculated at nearly the lowest load values for the planning horizon.

The ELCC value of a resource is dependent upon the peak load of the system in which it operates. Intuitively it is easy to understand that the addition of 40MW of solar on a 40MW system will have a large effect on the net load shape, while 40MW of solar on a 1000MW system will have a much smaller effect.

Astrapé and Duke have chosen to use a planning year of 2024 in the context of both growing energy demand and growing peak load through the 2021 to 2035 planning horizon. This decision to use a planning year at the beginning of the horizon results in a discounting of solar and storage ELCC values, as no load growth is incorporated.

If the Commission is of the view that the planning year should fall within the planning horizon, then I recommend the use of 2035.

RESPONSE TO WITNESS SNIDER

Q12. PLEASE SUMMARIZE WITNESS SNIDER'S TESTIMONY IN THE AREAS IT OVERLAPS WITH YOURS.

A: Witness Snider makes a number of points that I wish to address including:

1. The difficulty of adopting a UCAP PRM and the claimed small impact given thermal outages.

2. The practicality of using incremental demand response in the ELCC study.
3. The appropriateness of using a sequential approach instead of a co-optimization approach for solar and storage capacity additions.

Q13. DOES WITNESS SNIDER ADDRESS YOUR CONCERNS REGARDING DUKE'S DERATING OF SOLAR AND STORAGE CAPACITY CREDITS UNDER AN ICAP METHODOLOGY?

A: No, he does not. In his Rebuttal Testimony, Witness Snider does not address my testimony showing the under-valuation of solar and storage resources due to the use of ELCCs in defining capacity credit. Instead, he offers two primary arguments for not switching to a UCAP methodology:

1. It would require a significant re-design; and,
2. New thermal plants have very low forced outage rates.

Neither of these justifications deny the disadvantage applied to renewable resources based on the pairing of an ELCC and UCAP methodology. Furthermore, in my Direct Testimony I provided a work-around solution that involves minimal effort to which Witness Snider made no objection. In this work around solution, the ELCC values for renewables and energy storage resources would be grossed up by the outage rate of the thermal generation to effectively put them on a level playing field. Furthermore, Witness Snider's assertion that new thermal plants have "very low forced outage rates" seems to be in direct contradiction with Witness Wintermantel's assertion that it is critical to use seasonal outage rates for thermal plants in determining the ELCC values for solar and storage on the system.

The use of UCAP is industry standard and is used by the Public Service Company of New Mexico, the CPUC and Nova Scotia Power in their most recent IRPs as mentioned in my Direct Testimony. Witness Snider's rationale for Duke's continued use of ICAP, which as I discussed in my Direct Testimony, undervalues intermittent resources compared to thermal resources, does not justify the continued use of the ICAP methodology.

Q14. DOES WITNESS SNIDER AGREE WITH YOU THAT INCREASES IN DEMAND RESPONSE SHIFTS LOLE TO THE SUMMER?

A: Yes, he does. However, in his rebuttal testimony Witness Snider argues that this shift is inconsequential as the utility would remain Winter Planning.[3]

Q15. DO YOU AGREE WITH THIS CHARACTERIZATION?

A: No, I do not. The Duke systems use a 0.1 LOLE reliability planning standard: the IRP process is designed so that there is one loss of load event every ten years. By stating that shifting LOLE from the winter to the summer has no impact on planning, Witness Snider is essentially stating that summer outages do not matter. But, of course, summer outages matter very much to Duke's customers in the Carolinas, given the substantial cooling load.

[3] Rebuttal Testimony of Glen Snider - pg 126

The reality is that the generation mix on the system plays a large role in the net load that must be served, and a winter peaking system can still have capacity constraints in the summer (and vice versa.)

By ignoring summer LOLE in the capacity expansion process (by using exclusively winter ELCC values), Duke is inappropriately decreasing the value that solar and energy storage provide to the system.

Q16. DOES WITNESS WINTERMANTEL PRESENT DATA SUPPORTING YOUR POSITION THAT SUMMER LOLE IS IMPORTANT?

A: Yes. In his rebuttal testimony, Witness Wintermantel compares the LOLE results for both Astrapé's and E3's ELCC modeling of solar. These data are presented in Table 1 below.[4]

Table 1 – LOLE results from Astrapé and E3 ELCC modeling

	Astrapé 2018 Solar ELCC		E3[60]	
Solar Penetration	Winter LOLE	Summer LOLE	Winter LOLE	Summer LOLE
840	69%	31%	46%	54%
1,520	79%	21%	62%	38%
2,300	89%	11%	66%	34%
3,080	93%	7%	74%	26%
3,500	93%	7%	76%	24%

These results show that under all conditions, the Duke system has loss of load expectations in the summer months. Indeed, Astrapé's own modeling shows that

[4] Rebuttal Testimony of Nick Wintermantel - pg. 38

using current levels of solar penetration, 31% of the LOLE is in the summer. However, by arbitrarily defining the system as "winter planning" and attributing only winter ELCC values to solar, solar resources are not being allocated any of the capacity contribution that they provide the system in the summer, i.e., for 31% of the system's LOLE.

The Astrapé modeling clearly shows that the LOLE of a system is dynamic and shifts between seasons based on the resource mix (as solar is increased on the system, the LOLE shifts from summer to winter). These dynamics can only be represented using an annual ELCC value that takes into account the capacity contribution of resources in both the summer and the winter. In this case, Duke's use of a winter planning assumption results in an arbitrary and counterfactual discounting of the capacity contribution provided by solar on the system.

Q17. DO YOU AGREE WITH WITNESS SNIDER'S CHARACTERIZATION OF THE BENEFITS OF USING A SEQUENTIAL APPROACH TO MODELING STORAGE RESOURCES?

A: No, I do not. Energy storage assets present a unique opportunity for a utility as they can provide both capacity support during peak events as well as economic support by shifting low-cost power generation to times of higher cost.

Here are two examples outlining these realities:

1. During summer hours with low demand, solar energy can be stored by batteries that can then be released during peaking hours. By storing near zero variable cost generation and discharging in lieu of generating units with

higher marginal cost, the overall system, and thus ratepayers, experience cost savings.

2. In advance of a winter storm, energy storage can be charged using any generation technology (renewable, hydro, or thermal) and held for a number of days to support peaking load during the weather event. While this might not reduce the production costs for the system, it will increase the value of both the renewables and the demand response from a capacity perspective.

In his Rebuttal Testimony, Witness Snider indicates that a robust production cost methodology is required to evaluate the economic benefits of energy storage. I agree that examining an hour-by-hour dispatch of the system is necessary for the economic benefits of energy storage be evaluated. However, this evaluation alone does not allow for an understanding of the capacity benefits provided by storage resources.

As described in my Direct Testimony, the addition of battery storage to Duke's generation mix has synergistic effects with other resources including demand response and renewable generation such that the total capacity contribution of the three resource types is greater than the sum of their individual capacity contributions. Production cost modeling does not have the ability to evaluate these synergistic effects – a point that Mr. Snider does not seem to deny. Accordingly, production cost modeling alone fails to capture a significant portion of the value added by solar and storage when combined. Duke should re-run the capacity expansion component of their IRP using a single-step optimization methodology that allows for the diversity benefits of solar and storage to be captured.

<u>OVERLAP</u>

Q18. PLEASE DESCRIBE THE OVERLAP BETWEEN THESE TWO WITNESSES AS IT PERTAINS TO SEASONAL OUTAGE RATES.

A: In Witness Wintermantel's rebuttal testimony he indicates that the lack of cold weather outages in E3's analysis of the system would "show more LOLE in the summer LOLE for DEC" and cites this as an erroneous assumption leading to inflated ELCC values for solar.

In Witness Snider's rebuttal testimony, he notes that the use of the UCAP methodology is un-necessary as "new thermal resources have very low forced outage rates."

In this instance the witnesses seem to disagree with each other, as Witness Wintermantel indicates that cold weather forced outages are significant enough to affect the modeling of solar ELCC, while Witness Snider indicates that forced outage rates are low enough to have a negligible effect on the system's planning reserve margin.

In this instance I agree with Witness Wintermantel that seasonal outage rates are critical and, though requested, this information was not provided by Duke.

Q19. IN REVIEWING THE REBUTTAL TESTIMONIES OF WITNESSES WINTERMANTEL AND SNIDER, HAVE YOU CHANGED YOUR OVERALL OPINION IN THIS PROCEEDING?

No. After reviewing the rebuttal testimony from Witnesses Wintermantel and Snider, my recommendations for the Duke IRP remain unchanged. Specifically, I recommend Duke:

1. Re-run the capacity expansion component of their IRP using a single-step optimization methodology that allows for the diversity benefits of solar and storage to be captured. This is the most significant improvement that can be made within the scope of my analysis. Given that Duke is planning to move to a new capacity expansion model in the near future, there is now a unique opportunity for the Commission to require Duke to use a model that is capable of single-step optimization.
2. Correct the disadvantage currently being applied to renewables and energy storage due to the use of an ICAP PRM methodology. As outlined in my report, this can either be accomplished through the use of a UCAP PRM methodology, or by grossing up the value of the solar and storage ELCCs to account for thermal outage rates being assumed.
3. Use an ELCC surface to account for the dynamic and interactive effects of solar and storage penetration on the system.
4. Update the 2018 Solar Capacity Value Study to:
   - Vary ELCC as a function of loads; if Duke is unable to do that, I recommend they use 2040 levels for planning purposes,
   - Update DR values to include those identified in the most recent Winter Peak Demand Reduction Potential Assessment,

- Model energy storage resources on a preserve reliability basis as opposed to an economic arbitrage basis, and
- Change future solar technology from 60% tracking to 100% tracking.

Q20. DO YOU HAVE ANY OTHER COMMENTS TO MAKE AS PART OF YOUR SURREBUTTAL TESTIMONY?

A: Yes. I have addressed specific components of the rebuttal testimonies of Witnesses Wintermantel and Snider. Any lack of comment on any specific component of the rebuttal testimonies of Duke's witnesses does not indicate my agreement.

Q21. DOES THIS CONCLUDE YOUR TESTIMONY?

A: Yes, it does.